MIP equivalence of Vcsel measurements with SAMPIC

SNW, Nov. 27, 2014

We have routinely used ca.1000nm femtosecond lasers and pulsed 980 nm vcsel as a model for MIPs in developing the HFS (HyperFast Silicon) project.
This is a good model for MIP response to the extent that the small attenuation coefficient (10^2 cm^{-1}) results in uniform e-h deposition through the detector (and particularly the 40 micron depletion depth).
It is likely, but still being studied, that in the neighborhood of the MIP peak itself the effect of Landau/Vavilov (ie hard deltas) is not significant and the pulse shape is there also similar to that of the Vcsel model.
In detail and over the full MIP spectrum of response the optimal timing algorithm is certainly different for charged particles from that of Vcsel pulses.
But, so long as these algorithms are under development, the time jitter measured with a pulse height out of the APD(internal gain 200-500) and amplifier (40 dB and 50 dB used here) chain equivalent to what we obtain in an electron beam for the most probable is obviously a useful benchmark.

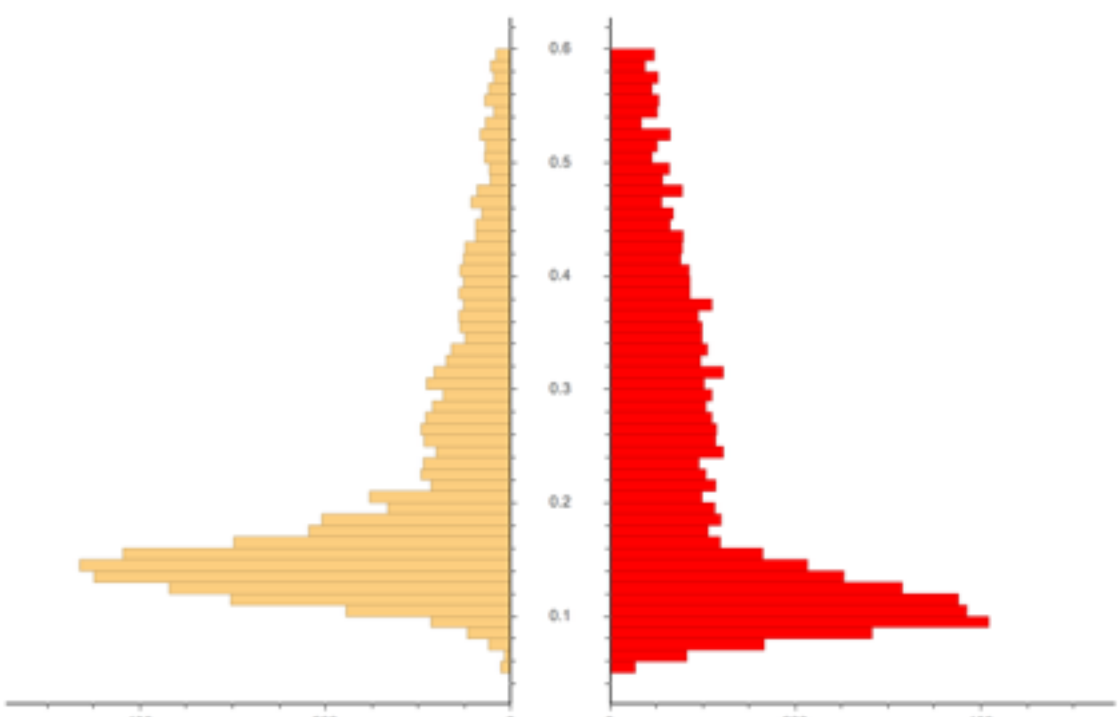
SAMPIC measurement on Nov. 21

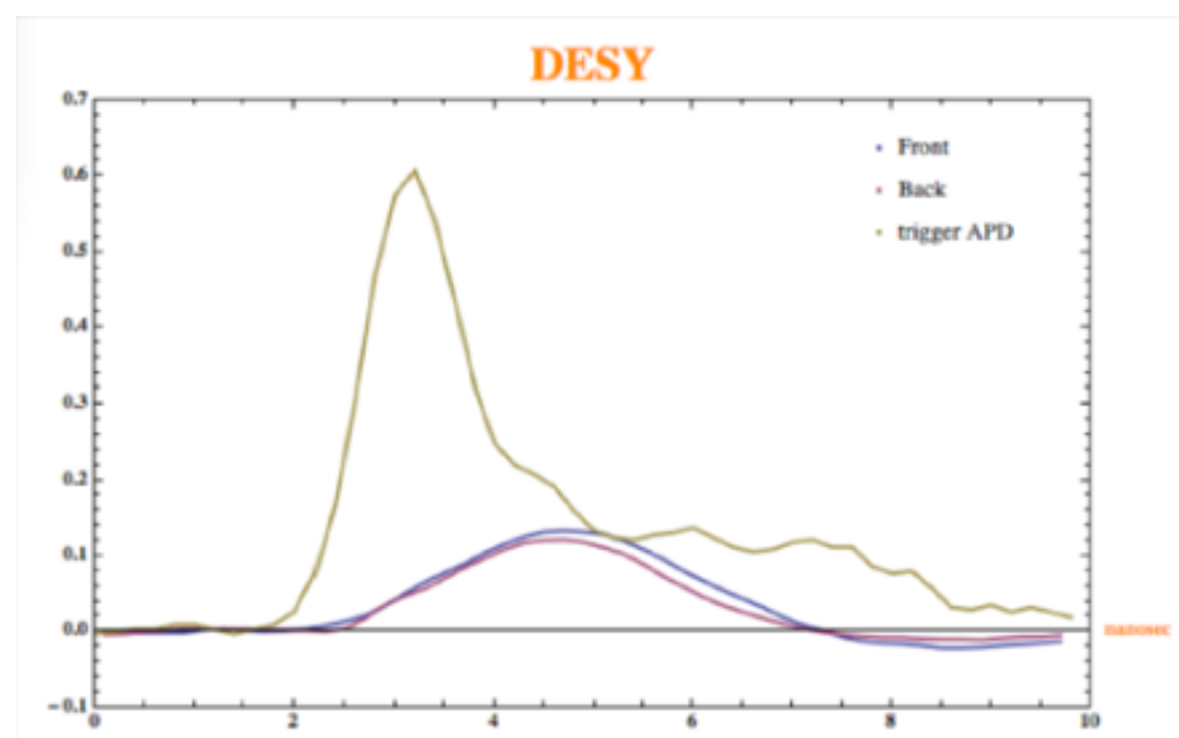
we'd like to refer these results to data taken in an electron beam at DESY last March but should take into account slightly different conditions of the measurements.

For the DESY measurements:

1)A wenteq (50 dB) amplifier was used for the trigger APD- just as was used in the SAMPIC measurements.

2) but a lower gain (40dB) Cividec amplifier was used on the 64mm2 APD tested with the SAMPIC.

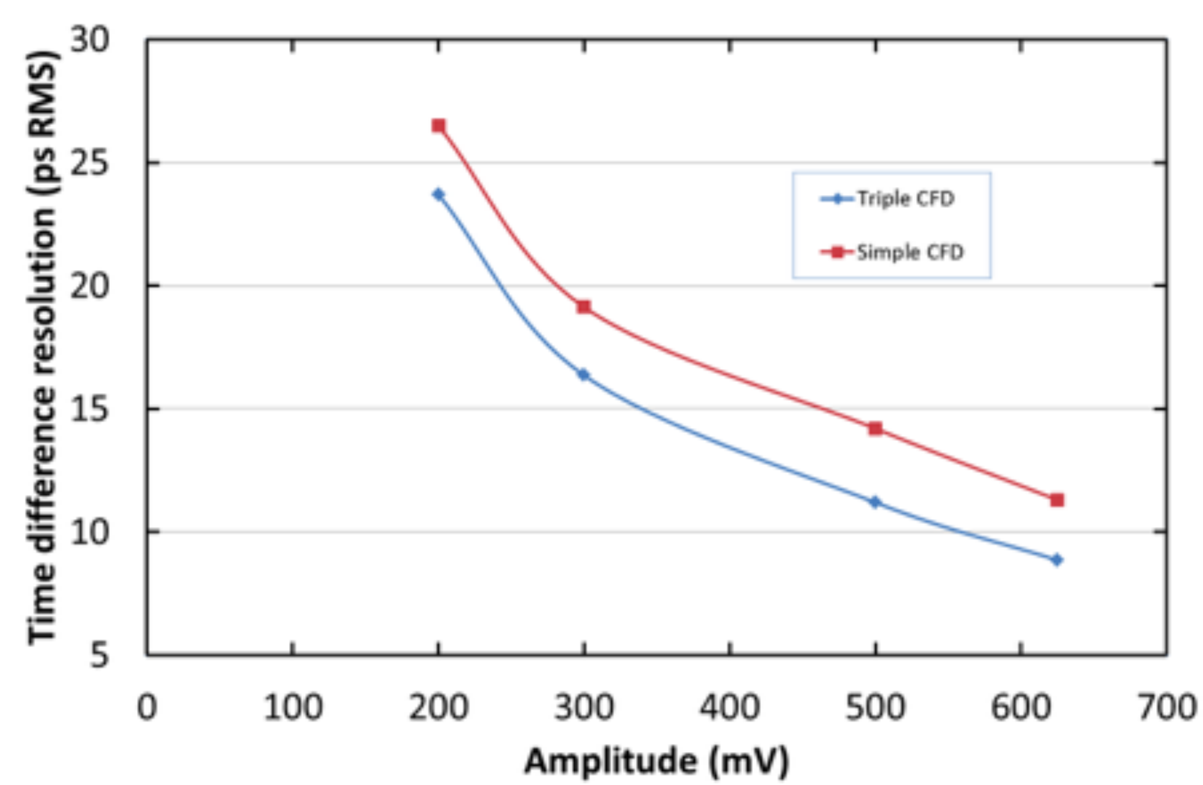


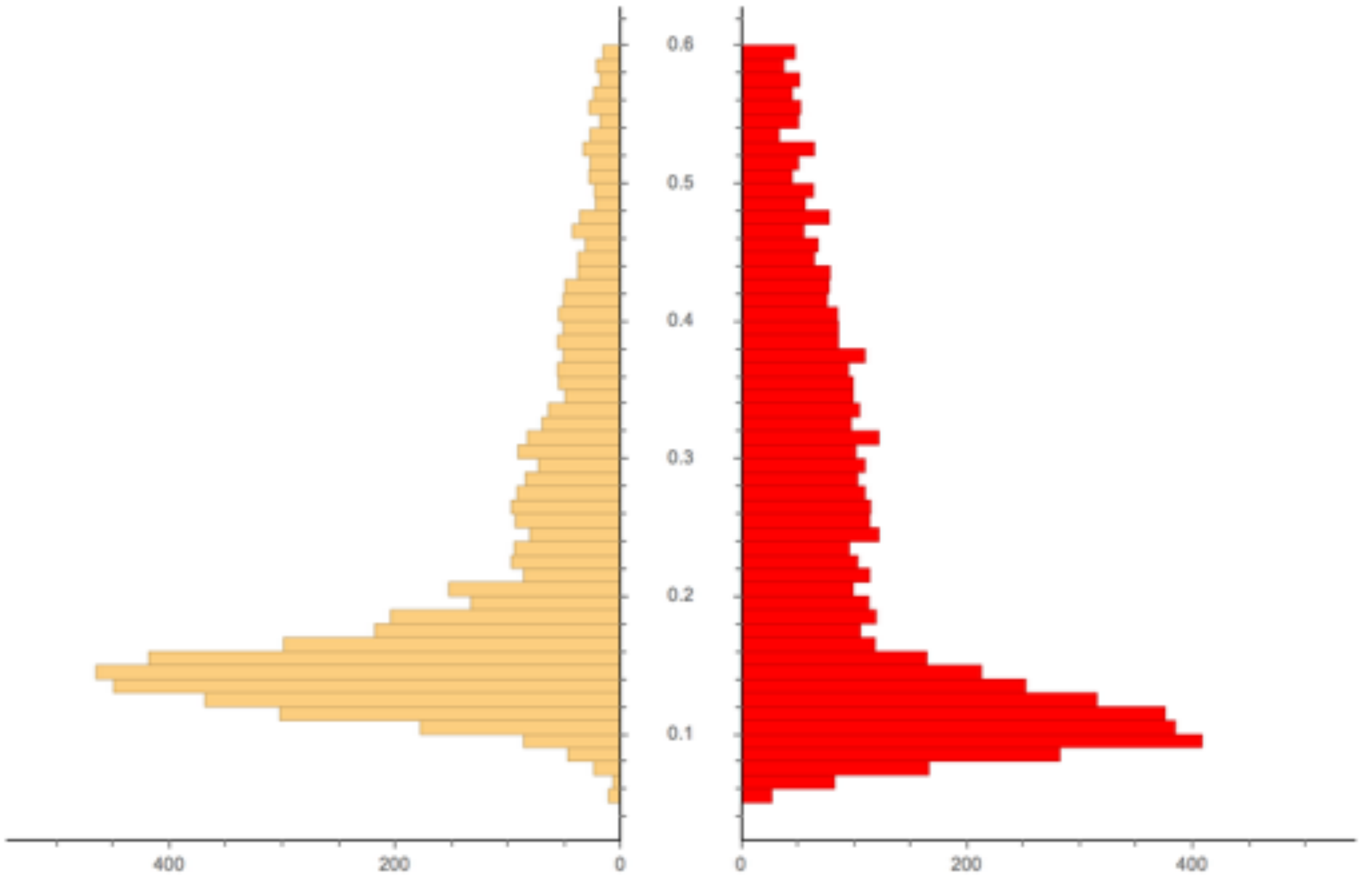


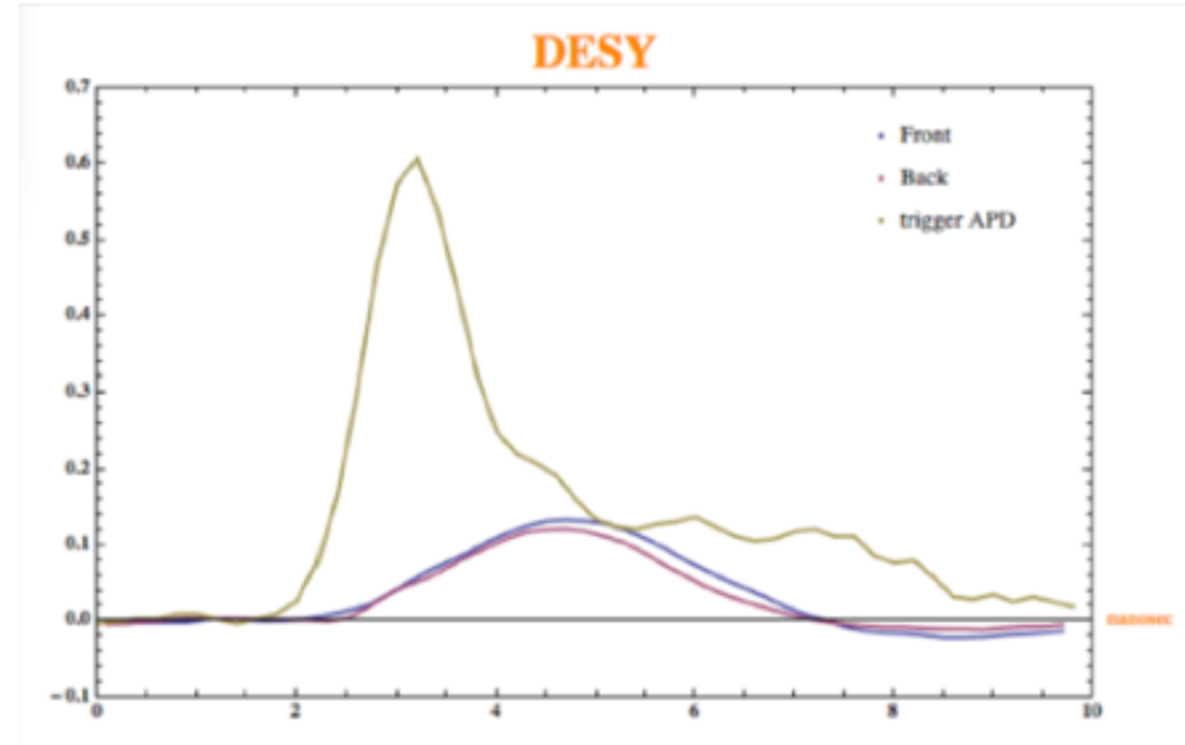
Either from the amplifier gain ratio between DESY and SAMPIC measurements (316:100) or reading directly the ratio in a typical event on previous page we would then conclude that the SAMPIC jitter plot should be labelled as
1 MIP equivalent at:
3.16*150mV=475mV.

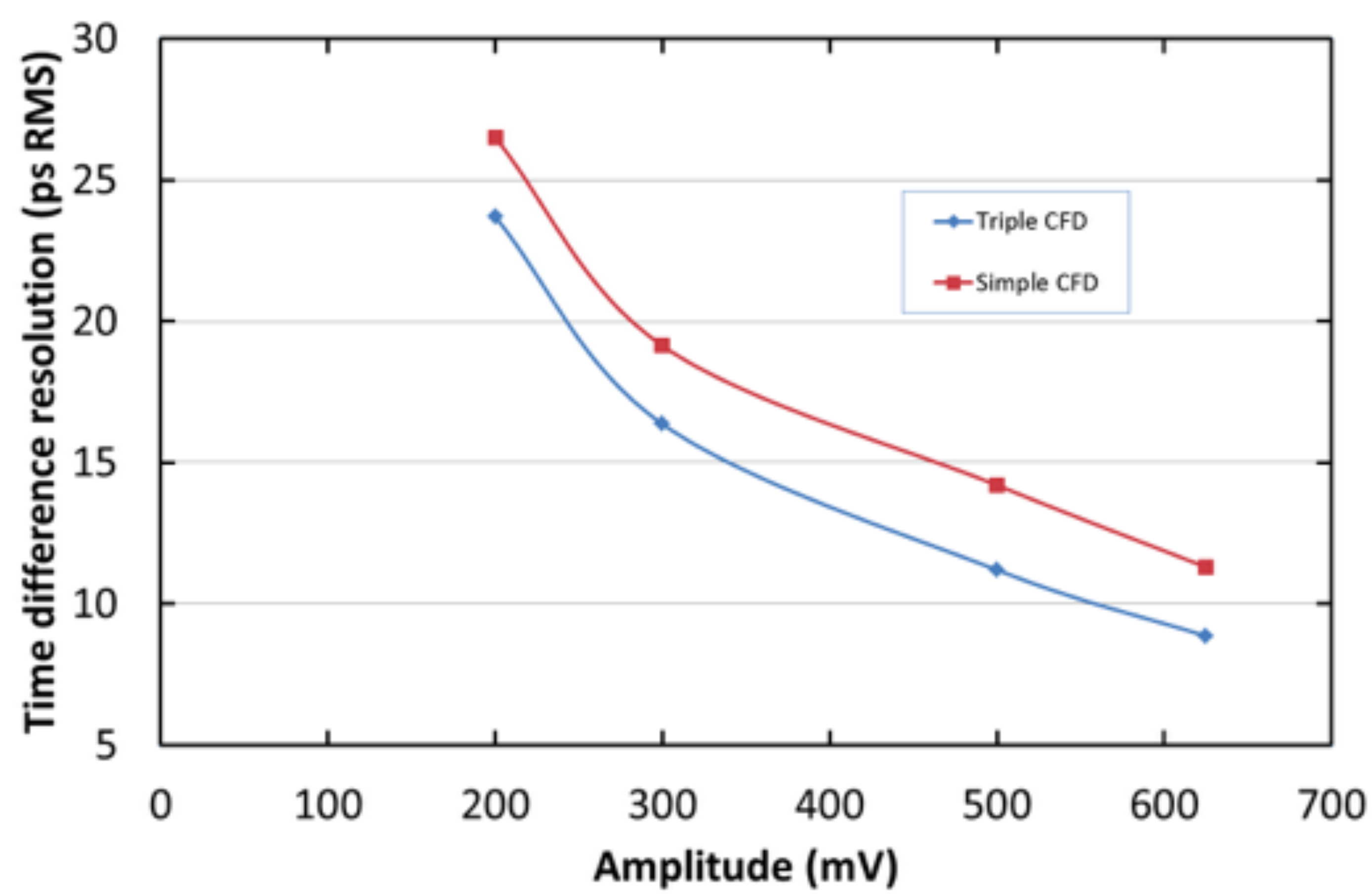
There is one minor difference in conditions in that the detector gains were not the same in the 2 measurements (1750V vs. 1795V). So you could argue that in the SAMPIC case the number of e-h pairs was higher to compensate for the factor of 2 lower gain.
To the extent that we are concerned about electronics and SNR I don't think this makes much difference but could easily test it by measuring jitter in the 2 cases.

Whichever way you chose to set the scale the result in Eric's note is obviously nice.






DESY
Front
Back
trigger APD


Time difference resolution (ps RMS)
Amplitude (mV)
Triple CFD
Simple CFD